INDUSTRIAL DIAMOND REVIEW

Vol 18 No 216
NOVEMBER 1958

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Industrial Diamond Review is published monthly at 1s 3d per copy, and is obtainable through newsagents and booksellers or by postal subscription (15s yearly, post free). Subscriptions in the United States of America are $2.50, and can be entered through the usual subscription agencies or direct through the publishers :—

N.A.G. Press Ltd
226 Latymer Court
London W.6.
(Telephone : RIVerside 2143).

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Generally Speaking

Cut on a Concrete Roof

To provide a weatherproof seal between the concrete parapet of a roof and the roof's covering of pitch, engineers recently decided that it would be necessary to cut a slit in the vertical wall of the parapet, parallel to the roof. In this way, the pitch would cover the roof and enter the slit, providing a good seal against rain. Two saw cuts had to be made, and the concrete between them chipped away by hand. Several methods of making the cuts were considered, and it was eventually decided that a small diamond impregnated blade, used with a wheel-mounted electric saw, would be most efficient. This equipment was used, and the results were entirely satisfactory.

da Vinci on Diamond

A useful handbook on diamond powders has recently been produced by a German firm[1]. The book contains a German translation of Leonardo da Vinci's formula for producing diamond powder. It was written by da Vinci in 1485, and, freely translated from the German, runs as follows :

> Diamonds are reduced to powder by wrapping them in lead foil and beating the foil with a hammer until it is considerably stretched. The foil is folded and wrapped in paper so that none of the powder escapes. Next, the lead is melted and the diamond powder comes to the surface of the molten lead. It is further reduced by crushing between two steel plates. Finally, it is washed in *aqua regis* to dissolve any lead remaining.

Stone Sawing in Canada

A circular stone saw weighing 10 cwt is being constructed in Canada. It is 9 ft in diameter, and will have 150 diamond teeth in the 11/32 in. thick edge. The saw will be the largest in Canada when it is finished. The diamond teeth will be installed by Millar Fast Cut Ltd., North Bay, Ontario.

1 Diamant Verwertungs GmbH.

*Diamond Machining and Thread Cutting on Aluminium**

by K. Sterl

Machining aluminium with diamonds

Owing to its great hardness, diamond covers a wide range of applications as a turning and drilling tool in the machining of aluminium (Fig 1 and 2). Its long life and the high surface finish obtainable with it offer considerable advantages over other known tools. By means of its use it becomes possible to obtain a surface finish of only 2 micro-in. roughness height without any additional finishing work.

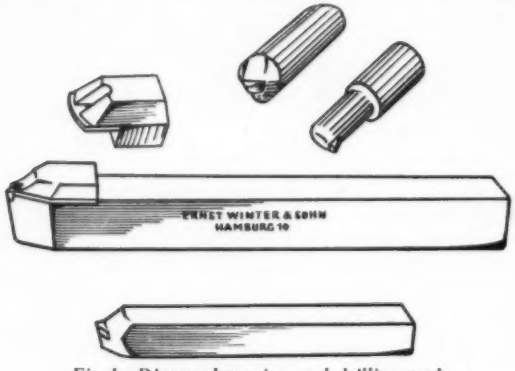
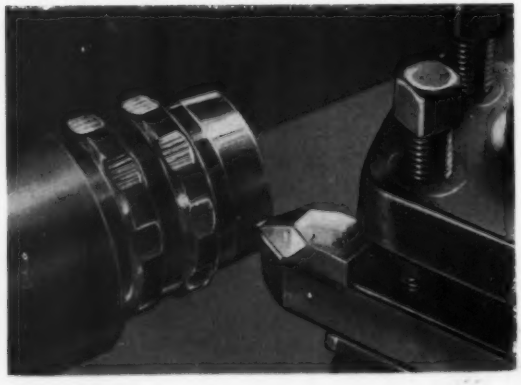


Fig 1. Diamond turning and drilling tools.

Owing to the sensitivity of diamond to impact and shock, great care must be taken to see that the workpiece comes into contact with the tool with a completely clean surface. Inclusions of casting sand, iron, or other hard substances would rapidly break up the sensitive cutting edge. A further requirement for satisfactory working is that the machine tool on which turning or drilling diamonds are to be used should be run without vibration. As high turning speeds are necessary, an endless driving belt must be used to reduce belt vibration. Also, built-in motor drives should be dynamically balanced.

Fig 2. Turning diamond set in position for working.



The cutting speed is unlimited. A speed of 400 m/min is recommended as economically practical. Depending on the surface finish to be obtained, the best rate of advance varies between 0.02 and 0.1 mm/rev, and the chip depth between 0.02 and 0.5 mm. It can be accepted that, as in other processes, the higher the cutting speed and the smaller the feed and chip depth, the better the surface finish obtained. The particular properties of diamond require tool shapes and cutting angles different from those of steel and sintered carbide tools. The rake angle must always be more rigidly kept in order to forestall the danger of breakage.

Fig 3 (left). Semi-circular and faceted cutting profiles of a turning diamond.

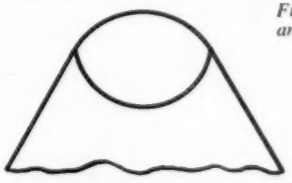
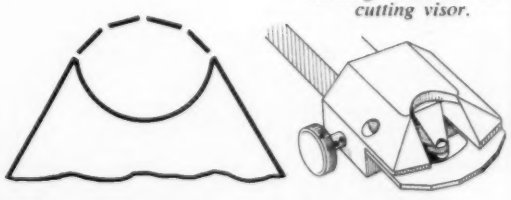


Fig 4 (below). Faceted turning diamond with cutting visor.



Diamonds for planing nearly always have a circular or faceted cutting edge (Fig 3). The first type, given exact central positioning, always produces the same outline, independent of whether the tool works in a right- or left-hand direction. With faceted cutting edges this is not the case, but this form of cutter has the

* Translated and reprinted by permission of *Aluminium* 1957 Vol 33 (9) pp 613-15 (Sep).

advantage that after one facet has become blunt, the next one can be brought into use. It is merely necessary to change the position of the holder. This positioning of the individual facets can be effected without any difficulty by means of a visor, for the facets formed on the visor are 10 to 20 times bigger than those on the diamonds and are parallel to them (Fig 4). It may be seen

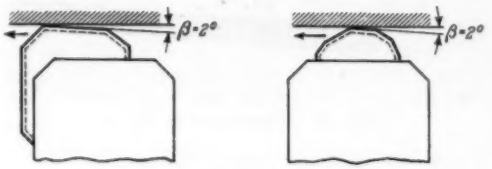


Fig. 5. Formation of the facets.

that the entire width of the facet does not touch the workpiece (Fig 5), otherwise vibration marks would appear. The angle is, as the illustration shows, chosen as being most favourable at 2°. If it is too big, there is a danger that the surface finish obtained will not have the desired characteristics.

The visor has another very useful function: it protects the inactive diamond edges from damage. The height positioning is effected by means of the sight, which is at the same height as the diamond cutter. For external work the tool is set centrally. If it is set beyond its centre, the clearance angle on the diamond becomes

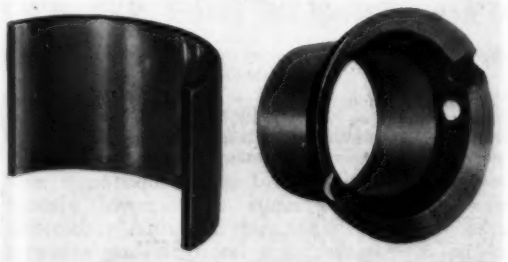


Fig 6. Workpieces with interrupted surfaces, as shown here, can also be worked with diamond.

smaller and produces a brighter surface. This type of setting must not be overdone, however, and in most cases, 1% of the workpiece diameter is sufficient.

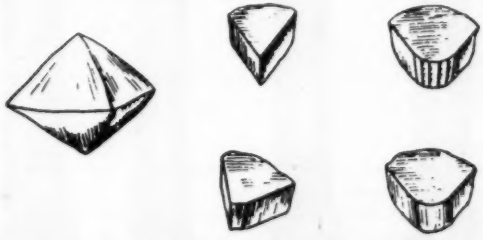
In turning and drilling care must be taken that the diamond is only brought in and out of the cutting position when the workpiece is turning at full speed. Workpieces with cavities, such as oil grooves, flats, and so on (Fig 6), can be precision machined without harm to the tool, if the requirements are known.

Fig 7. Grooving diamond in position for working.

Recently, besides the turning diamonds mentioned, those used for plunge-cut grinding have come to the fore. With these the full width of the tool is brought to the workpiece (Fig 7). By this method, highly polished surfaces can be obtained in a few seconds, and the method is very satisfactory for machining parts for the photographic, watch, and other precision industries. The well-known fine scribing of focusing scales on objectives is, for example, done in such a way that the figures and strokes are impressed in the aluminium rings before the finish machining. During the plunge machining with diamond which follows, the unevenness resulting from the impression is completely removed, so that the figures and scales have absolutely sharp outlines.

Besides their application in turning and drilling, diamonds have also assumed great importance in cutting-off tools, which are practically single-toothed cutters, in machining smooth aluminium surfaces.

Fig 8. Shapes of rough diamonds.



Apart from the fact that better surface finishes can be obtained by using diamonds for machining, a further advantage to be considered is that in the use of machine tools specially designed for precision work, smaller variations in size of the

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workpieces, even over a long period of time, are automatically attained.

It is important to know, for the installation of the tools, that the diamonds, with which thousands of close tolerance aluminium parts are to be machined, must be set up correctly, *ie* in a special direction with regard to the diamond structure. This means that the diamond must be cut from a good octahedron having all its edges (Fig 8). It can happen that the grinding loss is more than half the original weight (Fig 9).

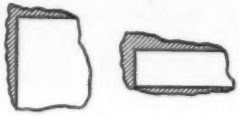


Fig 9. Flat natural diamonds, or cleavages; little diamond waste in the setting of a cutting tool, but considerably less resistance in use.

If the tool is cut from a diamond which was of a similar natural shape, or which was already cleaved in the desired shape, the loss of weight is naturally less; but the life of such a tool is much shorter, and this soon becomes evident from the smaller degree of stability in the cutting edge during use. As well as the suitable cutting qualities, the stability of the rough stone is of great importance. This accounts for a difference in price of more than 100% between two tools which appear exactly alike to the eye.

Fig 10 (left). Thread drill with interrupted teeth.

Fig 11. Thread drill with paring cutter (centre left) or left-hand spiral groove (centre right).

Fig 12 (right). Thread drill with right-hand spiral groove.

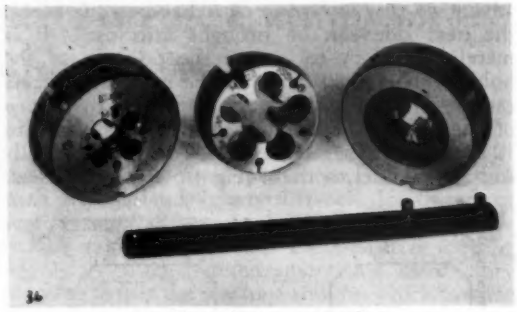


Fig 13. 'Elastic cutting-die'.

Cutting close tolerance threads in aluminium

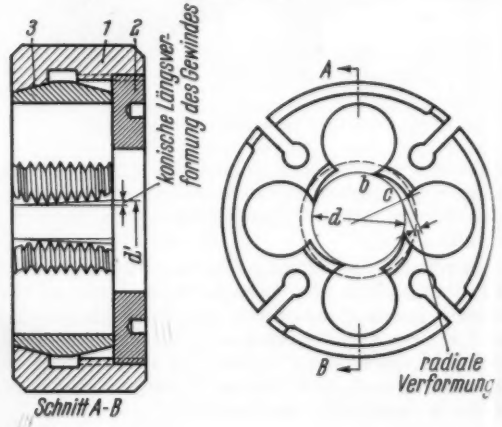
Cutting close tolerance internal and external threads in or on aluminium workpieces presents no difficulties, if care is taken to see that the proper tools for the operation are used.

For internal thread cutting, appropriate drills of HSS are used, of which the special features are a polished thread, narrow distance between threads, and wide grooves, profiled for easy chip flow, with a front rake of about 25°. In machining aluminium, short cutting lengths are required, even when it is a case of tools for through boring. For greasy and tough light metals the use of interrupted teeth is recommended (Fig 10), whereby the friction is considerably lessened and where the lubricant can flow better.

For through bores, the tool has a special peeling cutter or left-handed spiral groove

Fig 14. Schematic diagram of the working of the 'Elastic cutting-die'.

Translation: Schnitt A-B = section A-B; konische Laengsverformung des Gewindes = conical lengthwise formation of the thread; radiale Verformung = radial formation.



(Fig 11), which produces a longer peeling cut. In cutting with these drills, long curled shavings form which move forward in the direction of the drill feed, thus easing the machining considerably and reducing the cutting forces.

For blind end bores, right-hand spiral grooved drills (Fig 12) have been developed, in which the chips formed are pushed in the direction of the feed of the drill, and so out of the hole.

For external cutting, HSS cutting dies with narrow distances between threads, large chip holes, and a short throat in a lapped mount are used. A lapped thread profile is essential to avoid a premature clogging of the sides.

Besides the familiar cutting dies of DIN type, a tool of special construction is recommended for machining aluminium, this is called the elastic cutting-die DBP[1] (Fig 13 and 14). Apart from the previously mentioned characteristics, this special cutting die possesses special qualities which make it superior to the DIN cutting die for machining aluminium. This self-contained tool is not only able to be accurately centred to within 0.1 to 0.15 mm, owing to the sensible arrangement of double coned periphery surfaces with pressure cams connected to the receiving cap, which corresponds with DIN specifications in its external measurements, but the shaping which occurs by means of tightening the thrust washers causes the cutting grooves to be relief ground, thus providing very easy cutting and regular smooth threads. This tool combines high productivity with long life, and works out as no more expensive than normal DIN cutting dies, apart from the initial cost.

The best lubricant for thread cutting on or in aluminium is a good greasy cutting oil.

1 Produced by Moschkau & Gimpel, Lauf (Pegnitz).

Fabrication of Sapphire and Diamond Styli for Gramophone Pick-Ups*

by A. W. Ploegsma

Summary

A short illustrated description of the production of the extremely small sapphire and diamond styli for modern pick-ups. The sapphire styli are 0.4 mm in diameter and 1 mm long; diamond styli are even smaller. Some of the difficulties peculiar to the working of such small objects are described. Among the operations dealt with are the coning, radiusing, and mounting of the styli.

Introduction

Gramophone pick-ups with sapphire and diamond styli have largely replaced the older pick-ups which used interchangeable steel needles. One important reason for this lies in the enormously lower wear suffered by these hard materials. Although they are very much harder, sapphire and diamond cause much less record wear than steel needles: it is found that both distortion of reproduction and record wear are more dependent on the shape of the needle point than on other factors, so that the longer this is maintained the better. The photographs of Fig 1 show how well sapphire and diamond needles maintain their shape, even after hundreds of hours of use. A steel needle wears to the groove shape after only one playing. Another important advantage of the sapphire and diamond styli is that the moving system of the pick-up can be made with a much smaller moment of inertia than in the older types with their comparatively massive steel needle and holder. In modern pick-ups using sapphire and diamond styli, the effective mass at the needle point may be as little as 3 mg, resulting in a cut-off frequency due to stylus/groove resonance of the order of 20 kc/sec, which is well above the limit of the audible frequency range[1].

Sapphire and diamond styli for gramophone pick-ups are manufactured in the Philips diamond die factory at Valkenswaard (near Eindhoven).

Sapphire . . .

Sapphire cylinders, 3 mm long and 0.4 mm in diameter, cut from sheets of synthetic sapphire, are mounted in small rotating heads by means of shellac. A number of such heads are placed at an angle of 22½° to an equal number of cast-iron grinding wheels, the pores of which contain a little diamond dust in oil. The heads and the grinding wheels are rotated at high speed while at the same time the grinding wheels are given a

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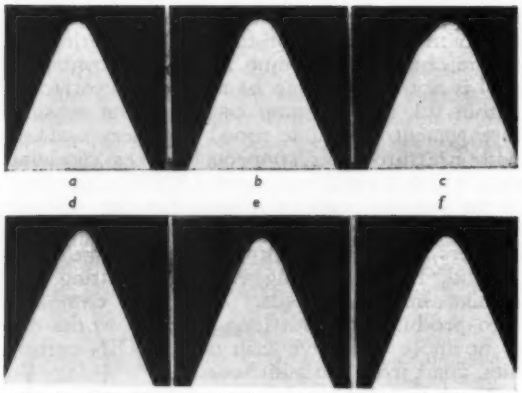
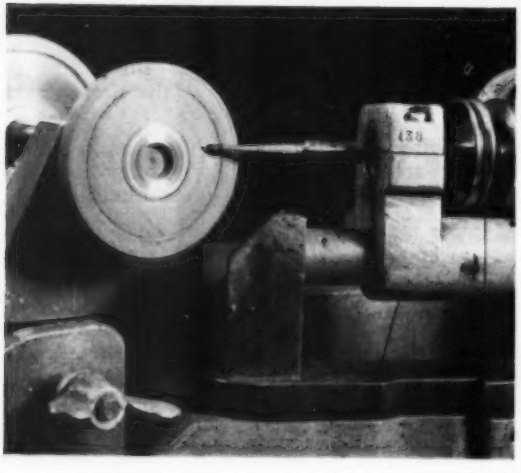


Fig 1. Comparative shadow photographs showing the wear of a microgroove sapphire stylus and a microgroove diamond stylus (tip radius 25 micron). The vertical force on the needle amounted to 12 grammes. For each stylus a new long-playing vinylite record was used, and the test continued throughout with the same record. It should be stressed that under these conditions the wear on the needle is far higher than ever occurs in practice. The microscopic particles worn from the needle are in normal circumstances distributed over a whole collection of records; here they are concentrated in the grooves of a single record, resulting in a much higher rate of wear. Furthermore, the photographs give no quantitative indication of the advantage of the diamond over the sapphire; in fact, the diamond may have a life of more than twenty times that of a sapphire point. (a) Unused sapphire stylus; (b) sapphire, after 75 hours; (c) sapphire, after 175 hours; (d) unused diamond stylus; (e) diamond, after 150 hours; and (f) diamond, after 300 hours.

Fig 2. Part of the 10-head machine for grinding cones on the ends of sapphire and diamond cylinders. The frame of the machine is suspended on four flexible steel strips. At one end of the machine a cam imparts a slow reciprocating movement to the whole frame, parallel to the surfaces of the grinding wheels. The sapphire or diamond cylinders are fixed in the rotating heads by means of shellac.



slow reciprocating movement parallel to their surface in order to obtain uniform grinding (Fig 2).

In this way the cylinder is given a conical end. The process is stopped, however, before the cone is sharp-pointed, as this tends to cause breakages during further handling. The sapphire cylinder is then reversed and the coning operation repeated on the other end. Subsequently the needles are broken in half, ground to a length of 1 mm, and cleaned; they are then ready for the radiusing of the points. This is done by placing a large number of them (several thousands) in a bottle containing diamond dust in oil. The bottle is then vibrated for several days, after which the points are found to be spherical in shape. The radius becomes greater as the vibration is continued. In this way the required radius (25 micron for microgroove records, 75 micron for normal 78 rev/min records) is easily obtained[2].

. . . and diamond

For diamond styli, selected stones are first cut parallel to the (111) plane to give plates 1.6 mm thick (Fig 3). From these plates, cylinders

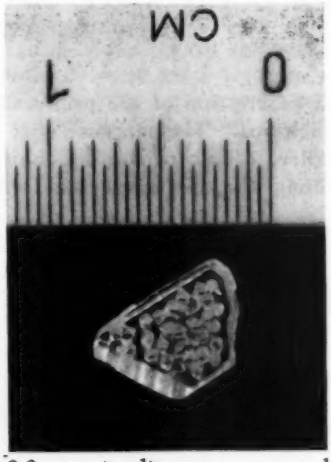


Fig 3. Diamond platelet, 1.6 mm thick, cut parellel to the octahedral (111) plane, and drilled out to give cylinders of 0.3 mm diameter (see Fig 4).

0.3 mm in diameter are cut by means of thin-walled nickel tubes rotating at about 10,000 rev/min, and containing diamond dust in oil. The ends of the cylinders which will become the points of the styli are therefore in the (111) plane. This plane is chosen partly because of its great wear resistance[3] but also because (111) faces of reasonable area can be cut from the natural crystal without too much loss of material. Next, a cone is cut at each end of the cylinder in the same way as for sapphire. In the case of diamond, however, the operation takes about 10 times longer. The radiusing of the ends

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cannot be effectively performed by the technique used for sapphire in view of the greater hardness and the fact that the mass of the diamond styli is considerably less. Diamond styli are therefore radiused by hand on a special grinding wheel. The rotating head containing the diamond stylus is removed from the coning machine and set in the radiusing machine; the latter is equipped with a microscope for control of the operation. The radiusing takes about one minute. The diamond cylinder is then reversed in the rotating head and replaced in the coning machine; this is again followed by the radiusing operation. After cleaving the pointed cylinder in half and cleaning, the styli are ready for mounting. Fig 4 gives an idea of the size of the diamond cylinder and the finished stylus.

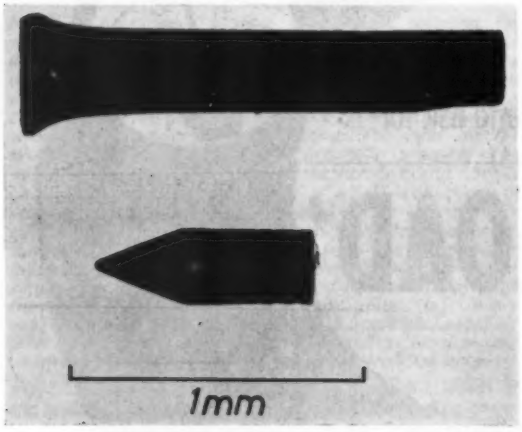


Fig 4. Above, shadow photograph of diamond cylinder as bored from diamond platelet; below, shadow photograph of finished stylus, 0.3 mm diameter, 0.6 mm long.

Diamond recovery

Of the original diamond, less than half can be drilled out into cylinders of the required dimensions. The remaining drilled stones are crushed to form diamond dust. Diamond dust is also recovered from the vicinity of the various grinding operations by means of carefully placed shields. After cleaning and grading into size ranges by centrifuging, the dust can be used again. There is, however, a surplus (mainly of the finest grades) and this is used for other purposes, *eg* for polishing in metallography.

Mounting

Both the sapphire and the diamond styli are mounted on the stylus arm by the same technique. A tiny aluminium bushing is picked up on the end of a 0.3 mm bore nickel tube through which air is sucked (tweezers are not very suitable for handling such small objects). The bushing is placed on a hollow jig mounted in a light press. Air is also sucked through this jig, and the dimensions and pressure are so chosen that the bushing is taken over from the nickel tube and seated in the correct position. A stylus is then

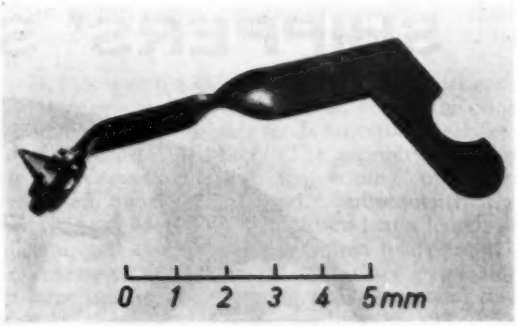
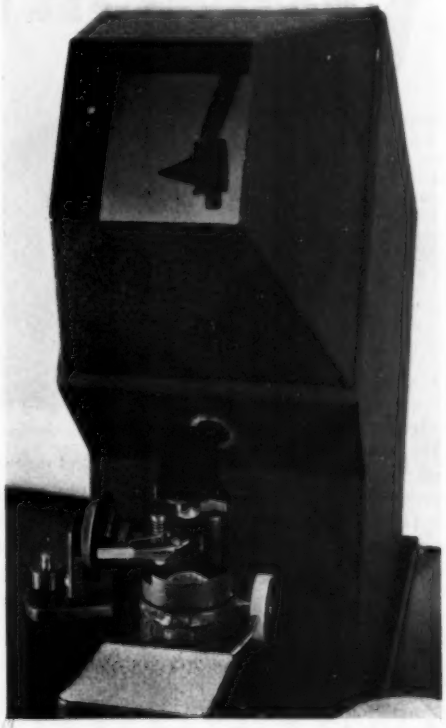


Fig 5. Finished stylus mounted on stylus arm.

Fig 6. Projection microscope (magnification 50 ×) for the individual inspection of mounted sapphire and diamond styli. Three lines on the screen serve for the checking of dimensions and alignment.



placed inside the bushing, point downards; the suction causes the point to come up against a stop which ensures a constant projection of the stylus below the stylus arm. The latter is placed round the bushing and the press operated, providing a completely rigid mounting for the stylus (Fig 5).

The mounted styli are then checked individually in low-power projection microscopes (Fig 6).

References

1 For an explanation of these terms and a fuller discussion of the questions involved, see J.B.S.M. Kerstens' 'Mechanical phenomena in gramophone pick-ups at high audio frequencies,' *Philips Techn Rev* 1956/57 Vol 18 pp 89-97; also N. Wittenberg, 'A magnetodynamic gramophone pick-up,' *Philips Techn Rev* 1956/57 Vol 18 pp 101-109, 173-178.

2 The same technique is used for rounding off the edges of quartz oscillator crystals.

3 See, for example, L. Schultink, H. L. Speir, and A. J. van der Wagt, *Philips Techn Rev* 1954/55 Vol 16 pp 91-97.

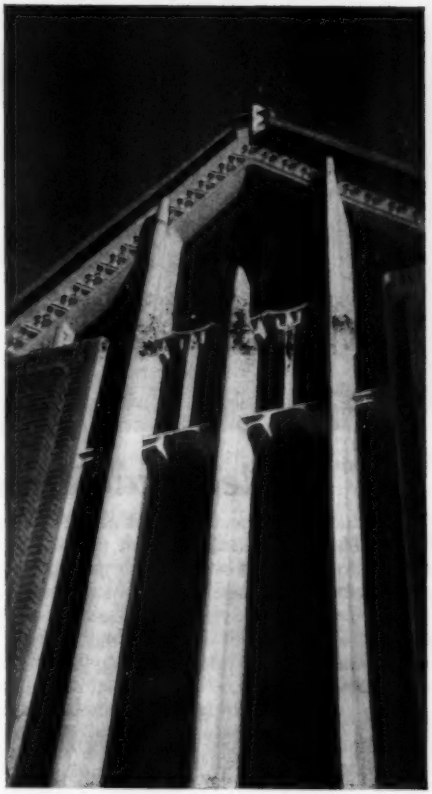
Engraved Glass Church Windows

Many of the readers of *Industrial Diamond Review* will have read in the National Press accounts of the church that has been moved bodily from Camberwell to Biggin Hill. The whole matter has been a remarkable example of enterprise and initiative in which the Vicar of Biggin Hill, the Reverend Vivian Symons, has played a leading part. The Parish of Biggin Hill, with little money and by hard work and improvisation, will in a few months have a fine, new church, built largely out of the materials of the demolished church at Camberwell.

Naturally, however, many things could not be provided in this way, and amongst the most important of these were the windows and the altar furnishings. Mr. Symons, an amateur silversmith of great ability, has made the latter, including a three-foot high altar cross, out of silver and jewellery given to him by well-wishers, and has made an excellent job of them. He has also made the windows for the church, and this is perhaps in many ways an even more remarkable feat.

It was felt that not only was stained glass too costly, but that the style of the church rendered such windows unsuitable, whilst on the other hand plate glass, either clear or frosted, would be uninteresting. Mr. Symons decided that he would be able to produce windows himself by engraving on tinted plate glass, that would be suitable and economical, and the result has proved that he was right.

Using a rose-tinted glass, Mr. Symons has engraved so far all the smaller windows, and has only the Great West Window to complete. His method is simple but effective. Using the woodcuts in an early printed bible as his models, he prepares a full-size cartoon of his design in black on white cartridge paper. The cartoon is fixed to an easel, and the sheet of glass, slightly larger than the required finished size of the light, is placed over it and fixed in position. The engraving is carried out with diamond or carbide burrs and wheels mounted in the chuck of an ordinary dentists' chair-side drilling machine. The sort of effect wanted determines the type of tool used, varying between very small diamond points for fine lettering and delicate detail work, to broad and coarse carbide burrs for giving a stippled effect on wide areas.



The Great West Window seen from the road.

When the whole design has been transferred to the glass, the glaziers take over and fit the window into its place in the church; so far there has been only one disaster with one of the completed windows being smashed at this stage.

The engraving on these windows has been

The Reverend Vivian Symons working on the figure of Christ which surmounts the Great West Window.

Photo by courtesy of Sevenoaks Chronicle.

done with a view to its being seen principally from the inside, and the engraved side of the glass is inwards. However, the Great West Window, which is high above ground, is engraved so as to be most effective when viewed from the outside, as this is the part of the church facing the main road; a slightly different technique was used here. In this case the glass was fitted in place first and engraved in position, using a small portable dentists' drill instead of the large one used in the studio engraving. In order to carry out the deeper engraving necessary to give the 'sculptured' effect, that makes the design properly visible from the roadway, only a diamond tool was used. The cut was both deeper and wider than used in the smaller windows.

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Tool Company Appointment

The Coventry Gauge and Tool Co. Ltd. announce the appointment of Mr. R. W. Boyd as Technical Representative for Scotland. Mr. Boyd, who was for some years Assistant Chief Draughtsman at the Brechin, Angus, factory, took up his new appointment on November 1.

*Electrical Diamond Die Drilling**

The introduction of electrical drilling of diamond dies has enabled manufacturers, both in this country and abroad, to achieve a considerable saving in time as against older processes. The process described here is that developed at the U.S. National Bureau of Standards ; it replaces the older mechanical die cutting method by high-voltage drilling followed by electrolytic drilling.

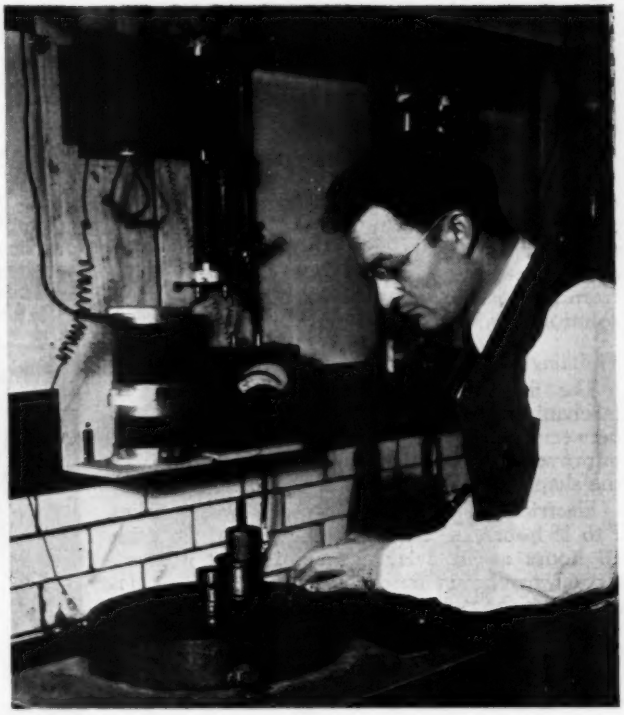
Method and equipment

The primary cone is drilled by means of high-voltage sparks formed at the point of a needle electrode in contact with the face of the diamond. These sparks release the energy stored in a condenser which has been charged to a high voltage by a transformer. The condenser is charged through a quenched gap consisting of a number of very small gaps in series.

When rising voltage is applied to the circuit, sparking occurs first at the quenched gap. This is followed, as the voltage is increased, by a discharge across the face of the diamond between the needle electrode and the brass block on which the diamond is mounted. Without the quenched gaps in the circuit, the discharge would be a more or less continuous arc, overheating the diamond and producing a dark deposit on its surface. The rate of drilling increases with the power input into the circuit until a limit is reached where the temperature of the diamond is too high and its surface takes on a frosty appearance. The drilling needle, which is 0.02 in. in diameter, becomes red hot at its tip before its frosting point is reached, and the reddening point of the electrode is used as a criterion in adjusting the power input on the circuit.

The secondary cone is formed by the action of a low-voltage spark in an electrolytic solution. The diamond is mounted on an insulating post in a shallow glass dish, and enough of the electrolyte is used to fill the dish and just cover the diamond. The Drolling electrode is a platinum-iridium needle which is lowered into contact with the bottom of the primary cone, and which rests with very light pressure (around one-fifth of a gramme) on the diamond. A second electrode dips into the solution at some distance from the diamond.

* Reprinted by permission from *The Wire Industry* 1958 Vol 25 (298) pp 963, 977 (Oct).



Plane-parallel surface and viewing window are cut on this rotating cast iron lap. An electric arc accelerates the action of the diamond powder abrasive.

Sparking forms smooth conical hole

When a low voltage (about 90 v) is applied between the electrodes, sparking occurs at the tip of the drilling needle, and a smooth-walled conical hole is formed in the diamond directly under the needle. The shape of the hole and the angle of its walls are controlled by the type of electrolyte used, while the hole size is controlled by the pressure of the needle against the diamond. The power input into the circuit is controlled by the depth of the solution covering the diamond and by the voltage applied.

The U.S. National Bureau of Standards' method of making small diamond dies consists essentially of ten steps which combine electrical with some mechanical drilling. The die blank used in these operations has two plane-parallel faces between which the die will be formed, and a side window for viewing the progress of the drilling. These are cut on the diamond using a rotating cast-iron lap with diamond powder as an abrasive. The cutting action of the lap is accelerated by the application of a high-voltage electric arc across the face of the diamond being cut.

In the first operation, ten minutes of high-voltage drilling of the blank, called spotting, produces a cone 0.014 to 0.020 in. deep which serves as a pilot hole for the next operation. This is followed by 30 to 40 minutes of mechanical drilling to cone out the hole, using diamond powder in a gelatin solution as the abrasive. Operation three is a repetition of the first high voltage drilling, and is followed by step four, mechanical coning. The final fore-drilling, operation five, should bring the bottom of the cone to between 0.006 and 0.008 in. from the back surface of the diamond. For exceptionally thick blanks, additional drilling and coning demands greater care than the other similar operations to assure a symmetrical shape, free from drilling rings, and with either a polished or fine matt surface. The diameter of the cone immediately above its apex should be between 0.002 and 0.003 in. for good blending of the primary and secondary cones.

Electrolytic drilling

Operation seven begins the series of three electrolytic drilling operations, using two different solutions—sodium chloride and potassium nitrate. The first drilling of the secondary cone utilises a 5% aqueous solution of sodium chloride.

Although an electrolyte of potassium nitrate produces a relatively long, narrow cone of correct size and shape for the secondary cone, the hole drilled using this solution tends to be out of alignment with the primary cone if drilling is attempted directly in a primary cone with a broad, unpointed, or irregular bottom. Excellent alignment and better blending of the primary and secondary cone is obtained by using sodium chloride, although an additional thirty minutes are needed for this step.

Drilling the main body of the secondary cone with potassium nitrate is similar to operation seven, except that the electrolyte solution is stronger and the tip diameter of the drilling electrode is smaller, ranging from 0.0010 to 0.0015 inch. After 40 to 45 minutes of drilling, the drill will have pierced the back face of the die, giving a smooth-bore cone with a length of

about 0.006 inch. If the initial distance between the bottom of the primary cone and the back of the die is greater than 0.005 in., the drilling may not pierce the back of the diamond, and an additional 40 minutes drilling with potassium nitrate, using a resharpened electrode, will be necessary.

The sharp edge formed at the intersection of the secondary cone and the back surface is given a slight countersink in the die. This countersink is made by inverting the die beneath the drilling electrode and drilling electrolytically from the back for four or five minutes, using the solution of sodium chloride.

Finishing and polishing

The final step is finishing and polishing, a mechanical operation that improves the blend between the primary and secondary cones, improves the roundness of the die, and improves the shape and polish of its working parts.

Electric drilling producing superior dies, takes 7 to 15 hours, depending on the type of die, with 10 hours as an average for this new process. Actual man-hours are considerably less than this, averaging about 2 man-hours/die, because almost every stage in the process is easily adaptable to multiple production.

Dies produced by this method have better wear characteristics in service than those produced by purely mechanical methods. In mechanically drilled dies, holes are started in the top and bottom of the diamond by bruting or gouging the face of the diamond with a small diamond chip. The hole is drilled through the body of the diamond by packing it with a spinning steel needle charged with diamond powder, a sort of star drilling process. These operations result in severe strains and minute fractures in the walls of the die cones, and although the magnitude of the strain resulting from mechanical drilling decreases with reduced load on the drilling needle and with the size of the diamond powder used, it is still present in most mechanically drilled secondary cones. Frequent failure by chipping at the intersection of the secondary and exit cones of dies so drilled is ascribed to weakening of the material by the mechanical treatment. Likewise, rapid wear of some dies at their initial size may be attributed to disruption of material underlying the working surfaces of the dies that has not been removed by sufficient polishing.

Advantages of the method

In contrast to the condition found in mechanically drilled dies, cones produced by either the high-voltage or the electrolytic drilling process show no strain in the surrounding material when examined under polarized light. The freedom from strain and fractures results in less wear as the die is used to draw wires. The electrical methods of die formation are therefore particularly adapted for small dies used in drawing wires 0.0015 in. in diameter or smaller.

The electrical method requires no special skills or long training on the part of operators. Equipment is inexpensive and the drilling technique is simple, making the work less tedious and more practical for small as well as large scale enterprise.

The Diamond Tool Research Co. Inc. display, seen above, was a feature of the American Mining Congress Exhibition held in San Francisco during the latter half of September. Films shown on the stand included a De Beers' film of the mining of diamonds, and exhibits included diamond drill bits and rough diamonds.

Representatives from almost every country in the world exhibited, including the Communist countries.

Powder Metallurgy Glossary

Forthcoming issues of a contemporary journal *Metal Powder Report* will include a glossary of all important terms used in powder metallurgy, a field of some interest to the diamond tool industry. The glossary will be published in the principal European, Asian, and African languages including Afrikaans, Arabic, Chinese, Hebrew, Japanese Russian, and Turkish.

Metal Powder Report is published monthly by Powder Metallurgy Ltd, Berk House, Portman Square, London W 1.

Eleventh Engineering Display

London, Oct 21-23, 1958

The Exhibition was held in the Royal Horticultural Society's New Hall, Westminster.

Two stands showed industrial diamonds, but these were not featured and were only incidental to the rest of the display. The diamonds were on the stand of Lorant & Co Ltd., who displayed a selection of small diamond tools formed by the electro-deposition process, and on the stand of O. Florin Ltd., who showed glaziers' diamonds.

Endecotts (Filters) Ltd. had a working demonstration of automatic sieves. These are available in US National Bureau of Standards sizes down to 400 mesh, and down to 350 mesh in British Standard sizes.

Many varieties of grinding machine were exhibited, including the 'Cat' tool grinder which uses a 3-in-1 grinding wheel. It permits boring tools to be ground in the bore of the grinding wheel, thus generating an arc on the tool being ground. Diamond laps are available at extra-cost. Several Myford machines were publicized on the stand of the A. Douglas Co. Ltd., including the MG 12 cylindrical grinder for which a swivelling workhead is available. A table-type wheel truer is supplied, but without the diamond.

Other exhibits included a variety of boring, milling, and turning devices, but no emphasis was given to the applications of diamond tooling on these machines.

(Opposite) The 'Cat' tool grinder.

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Coldset Corporation Appointments

The following agents for diamond tools and diamond grinding wheels have been announced by the American Coldset Corporation:

Northern Ohio	Mr. C. R. Gilmore, 14512 Fairlawn Avenue, Cleveland 11.
Florida	Mr. E. B. Narber, 279 Atlantic Avenue, Miami.
Maryland and E. Pennsylvania	Bucheimer Tool Sales Co., 24 West Alleghany Avenue, Towson, Maryland.
New York City, Long Island, Staten Island, and S.E. New York State	Mr. G. R. Davenport, 5 Tudor Place, Hartsdale, New York.

Telegrams:
Inland: Eldevries, Cent, London.
Overseas: Eldevries, London.

L. de VRIES & SON LTD.

Telephone: HOLborn 5097

11, HATTON GARDEN, LONDON, E.C.1.
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WE STOCK DIAMONDS FOR
ALL INDUSTRIAL PURPOSES

Industrial Diamonds in the United States

This pictorial analysis clearly shows the distribution pattern for industrial diamonds used in the United States. It can be seen that of the total number of carats consumed, 40% are accounted for by mining bits and saw blades, 40% by grinding wheels, and 20% by miscellaneous applications.

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World's largest

The U.S. is the world's largest importer of industrial diamonds, although not all the diamonds are for domestic use. Some of them are made into tools and exported, as, for instance, diamond drill bits for Canada. An important factor in domestic consumption is defence production, but besides this there is a large civil industry which requires diamond tools. One of the leading civil consumers is the motor car industry: it is estimated that each car produced in the United States uses up almost one dollar's worth of industrial diamonds. As the 1957 production of passenger cars alone totalled 6,212,291, it is obvious that if trucks, lorries, motorcycles, *et cetera*, were to be included in these figures, then the industry would probably account for some 10,000,000 carats annually.

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That 20% . . .

The items which constitute the 20% of diamond tool production are so diversified that it would be impossible to compile a complete list of the uses in this category. The selection shown here does, however, suffice to convey the significance of this 20%. Two items, taken at random from this section, indicate the varying requirements of these tools in terms of diamonds: for truing tools (c) 600,000 carats are required annually, and wire drawing dies (g) account for about 50,000 carats. The key to the section is as follows: (a) early gramophone point ; (b) engraving tool; (c) truing tool; (d) watch bearing; (e) indenter; (f) shaped tool; (g) drawing die; (h) powder; (i) dental tool; (j) glass cutter; and (k) centring drill.

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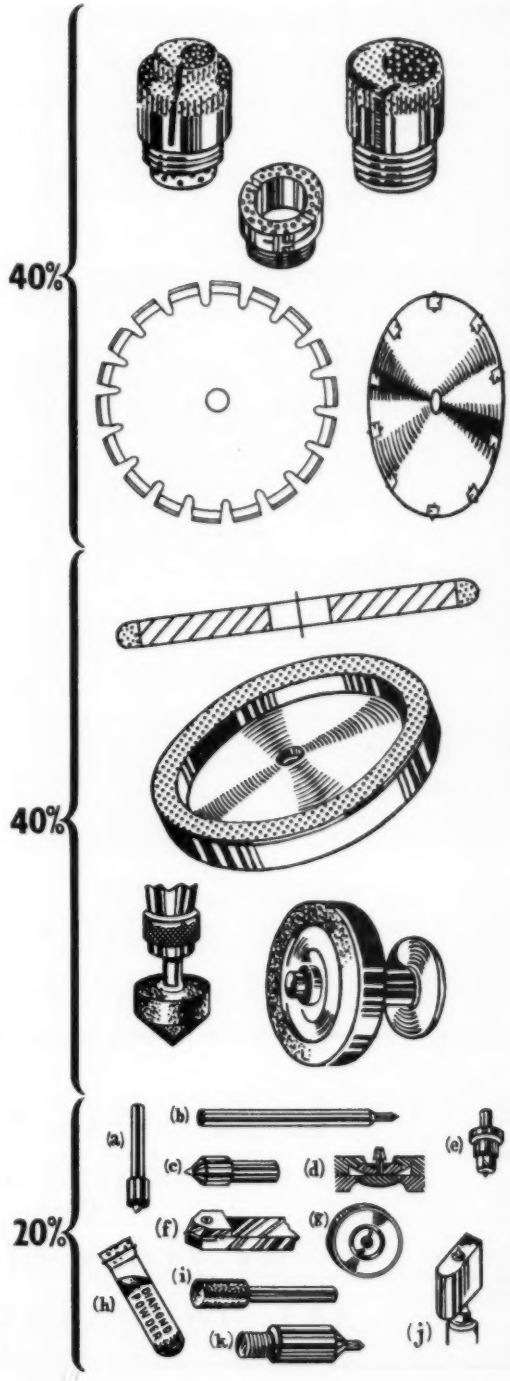
Economy

As much as 10% of the total number of carats consumed in the United States each year is reclaimed by modern recovery methods: this was equivalent to a saving of over 1½ million carats in 1956.